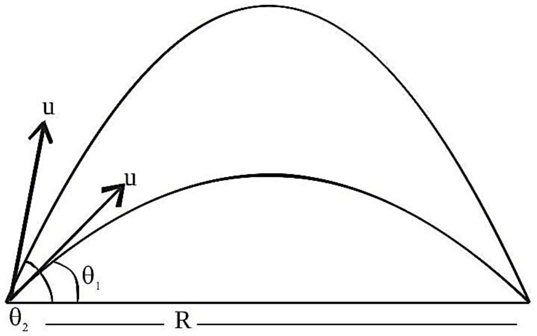
**1.** **(a)** For same range $\theta_1 + \theta_2 = 90^\circ$




$h_1 = \dfrac{u^2 \sin^2 \theta_1}{2\,g}$ $h_2 = \dfrac{u^2 \sin^2 \theta_2}{2\,g}$

TEST PAPER WITH SOLUTION

$$h_1\, h_2 = \frac{u^2 \sin^2 \theta_1}{2\,g} \times \frac{u^2 \sin^2 \theta_2}{2\,g}$$

$$\theta_2 = 90 - \theta_1$$

$$h_1\, h_2 = \frac{u^2 \sin^2 \theta_1}{2\,g} \cdot \frac{u^2 \cos^2 \theta_1}{2\,g}$$

$$= \left[\frac{u^2 \sin \theta_1 \cos \theta_1}{2\,g}\right]^2$$

$$= \left[\frac{u^2 \sin \theta_1 \cos \theta_1}{2\,g} \times \frac{2}{2}\right]^2 = \frac{R^2}{16}$$

$$R = 4\sqrt{h_1\, h_2}$$

So R is correct explanation of A

**2.** **(d)** $X_P(t) = \alpha t + \beta t^2$ $X_Q = ft - t^2$

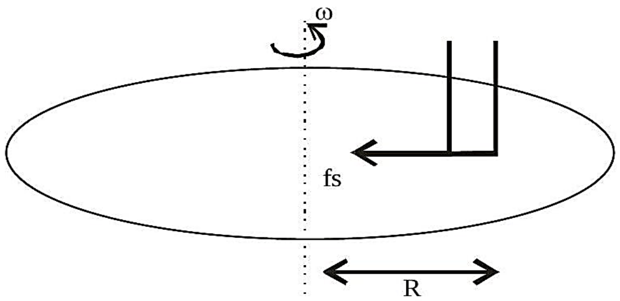
$$V_P(t) = \alpha + 2\beta t \; V_Q = f - 2t$$

$$V_P = V_Q$$

$$\alpha + 2\beta t = f - 2t$$

$$t = \frac{f - \alpha}{2\beta + 2}$$

**3.** **(b)** For beaker to move with disc




$f_s = m\omega^2 R$

We know that $f_s \le f_{smax}$

$m\omega^2 R \le \mu mg$

$R \le \frac{\mu g}{\omega^2}$

**4.** **(b)** Increase in volume $\Delta V = \gamma V_0 \Delta T$

$\gamma = 3\alpha$

So $\Delta V = (3\alpha)V_0\Delta T$

Total surface area $= 6a^2$, where $a$ is side length

$24 = 6a^2$ $a = 2m$

Volume $V_0 = (2)^3 = 8\ m^3$

$\Delta V = (3 \times 5 \times 10^{-4})(8) \times 10$

$= 1.2 \times 10^5\ cm^3$

**5.** **(c)** Heat given by block to get 0°C temperature

$\Delta Q_1 = 5 \times (0.39 \times 10^3) \times (500 - 0)$

$= 975 \times 10^3$ J

Heat absorbed by ice to melt m mass

$\Delta Q_2 = m \times (335 \times 10^3)$J

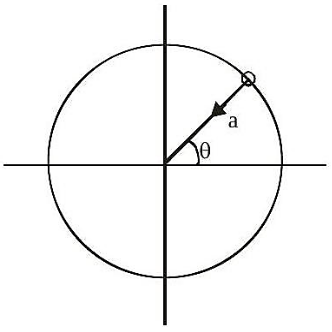
$\Delta Q_1 = \Delta Q_2$

$m \times (335 \times 10^3) = 975 \times 10^3$

$m = \frac{975}{335} = 2.910$ kg

**6.** **(b)** Molar heat capacity at constant volume $C_V = \frac{fR}{2}$ where f is degree of freedom. Molar heat capacity at constant pressure can be written as $C_P = R + C_V = R + \frac{fR}{2} = \left(1 + \frac{f}{2}\right)R$ So $\frac{C_P}{C_V} = 1 + \frac{2}{f}$

**7.** **(c)** $a = |\vec{a}| = \frac{V^2}{R}$




$\vec{a} = -a\cos\theta\hat{i} - a\sin\theta\hat{j}$

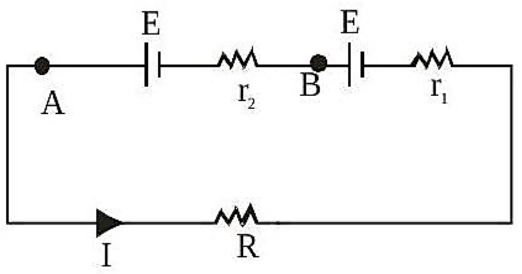
$= -\frac{V^2}{R}\cos\theta\hat{i} - \frac{V^2}{R}\sin\theta\hat{j}$

**8.** **(a)** $C_1 = \frac{\epsilon_0 A}{d}$

$C_2 = \frac{\epsilon_0 \ A}{\frac{d}{2} + \frac{d/2}{\propto}} = \frac{2\ \epsilon_0 \ A}{d}$

$\frac{C_2}{C_1} = \frac{2}{1}$

**9.** **(a)** $I = \frac{2E}{R+r_1+r_2} \ldots\ldots(\text{ i})$




But $V_A - V_B = E - Ir_2 = 0$

$\Rightarrow I = \frac{E}{r_2}$

Comparing values of I from (i) and (ii)

$\frac{E}{r_2} = \frac{2E}{R + r_1 + r_2}$

$\Rightarrow R = r_2 - r_1$

**10.** **(a)** According to curie's law, magnetic susceptibility is inversely proportional to temperature for a fixed value of external magnetic field i.e. $\chi = \frac{C}{T}$. The same is applicable for ferromagnet & the relation is given as $\chi = \frac{C}{T-T_C}$ ($T_C$ is curie temperature) Diamagnetism is due to non-cooperative behaviour of orbiting electrons when exposed to external magnetic field.

**11.** **(a)** $B_1 = \mu_0 nI$

$B_2 = \mu_0 \left(\frac{n}{2}\right)(2I)$

$\Rightarrow B_1 = B_2$

**12. (a)** $X_L = 10^{-2} \times 3000 = 30\Omega$

$X_C = \frac{1}{3000 \times 25 \times 10^{-6}} = \frac{40}{3}\Omega$

$X = X_L - X_C$

$= 30 - \frac{40}{3} = \frac{50}{3}$

$\tan\delta = \frac{X}{R} = \frac{50}{3 \times 100} = \frac{1}{6}$

$\delta = \tan^{-1}\left(\frac{1}{6}\right) = \tan^{-1}(0.17)$

**13. (a)** $V = 2 \times 10^8$ m/s

$C = 3 \times 10^8$ m/s

$\frac{C}{V} = \sqrt{\mu_r \epsilon_r}$

$\frac{9}{4} = 1 \times \epsilon_r$

$\epsilon_r = \frac{9}{4} = 2.25$

**14. (b)** $\frac{I_1}{I_2} = 4$

$\frac{I_{max}}{I_{min}} = \left[\frac{\sqrt{I_1} + \sqrt{I_2}}{\sqrt{I_1} - \sqrt{I_2}}\right]^2$

$\frac{I_{max}}{I_{min}} = \left[\frac{2\sqrt{I_2} + \sqrt{I_2}}{2\sqrt{I_2} - \sqrt{I_2}}\right]^2$

$\frac{I_{max}}{I_{min}} = 9$

$\frac{I_{max} + I_{min}}{I_{max} - I_{min}} = \frac{10}{8}$

$\frac{5}{x} = \frac{10}{8}$

$\mathbf{x} = 4$

**15. (d)**

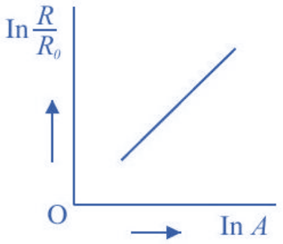
**16. (b)** $\lambda = \frac{h}{\sqrt{2Em}}$

$\lambda \propto \frac{1}{\sqrt{m}}$

$\therefore\ \lambda_e > \lambda_p > \lambda_n > \lambda_\alpha$

**17. (b)** $R = R_0\ A^{\frac{1}{3}}$

$\ln \frac{R}{R_0} = \frac{1}{3} \ln A$




**18. (a)** $= [\overline{\overline{A + A}}] + [\overline{B + B}]]$

$Y = \overline{\overline{A} + \overline{B}}$(D′ MORGAN LAW )
$Y = AB$

**19. (b)**
**20. (d)**

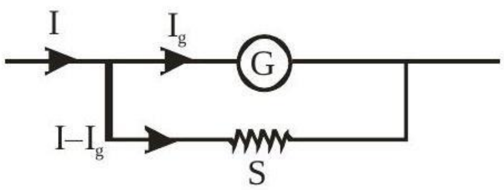



Figure of merit $\frac{I_g}{\theta} = K$

$I_g = Kn$

$I = \frac{I_g}{S}(G + S)$

$I = \frac{nK}{S}(G + S)$

**21. (18)** $z = a^2 x^3 y^{1/2}$

$\frac{\Delta z}{z} = \frac{2\Delta a}{a} + \frac{3\Delta x}{x} + \frac{1}{2}\frac{\Delta y}{y}$

a is constant

$\frac{\Delta z}{z} \times 100 = 3(4\%) + \frac{1}{2}(12\%) = 18\%$

**22. (24)** $f_{s\ max} = \frac{mv^2}{R}$

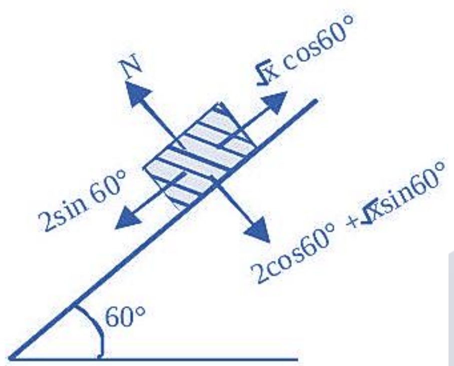
$$\mu mg = \frac{mv^2}{R} v = \sqrt{\mu Rg}$$

$$\frac{v_2}{v_1} = \sqrt{\frac{R_2}{R_1}}$$

$$\frac{v_2}{30} = \sqrt{\frac{48}{75}}$$

$$v_2 = 24 \text{ m/s}$$

**23. (12)** $mg = 2$ N




$$\sqrt{x}\frac{1}{2} = \frac{2\sqrt{3}}{2}$$

$$x = 12$$

**24. (5)** $I_1 = \frac{2}{5}M(2R)^2 = \frac{8}{5}MR^2$

$$I_1 = \frac{1}{2}M(2R)^2 = 2MR^2$$

$$I_3 = \frac{M(2R)^2}{4} = MR^2$$

$$I_4 = \frac{M(2R)^2}{2} = 2MR^2$$

$$2(I_2 + I_3) + I_4 = xI_1$$

$$8MR^2 = x\frac{8}{5}MR^2$$

$$x = 5$$

**25. (2)** $V = \frac{GM}{r} \Rightarrow \frac{V_1}{V_2} = \sqrt{\frac{800}{3200}} = \frac{1}{2}$

**26. (250)** $pV = nRT$

$$\Delta P . V = nR\Delta T$$

$$\Rightarrow \frac{\Delta P}{P} = \frac{\Delta T}{T} = \frac{0.4}{100}$$

$\Rightarrow\ T=\dfrac{100\times 1}{0.4}=250\ K$

**27. (198)** $q\to nq$

$n\dfrac{4}{3}\pi r^3=\dfrac{4}{3}\pi(r')^3$

$\Rightarrow r'=n^{\frac{1}{3}}r$

$V=\dfrac{kq}{r}\propto\dfrac{n}{n^{1/3}}\propto n^{2/3}\propto 27^{2/3}\Rightarrow v'=9\ V=9\times 22=198$

**28. (300)** $V'=V$

$\ell' A=\ell A$

$2\ell A'=\ell A$

$A'=\dfrac{A}{2}$

$R=\rho\dfrac{\ell}{A}$

$\ell'=2\ell$

$A'=\dfrac{A}{2}$

$R'=\dfrac{\rho\ell'}{A'}=\dfrac{\rho 2\ell}{\frac{A}{2}}$

$R'=\dfrac{4\rho\ell}{A}$

$R'=4R$ from equation (i)

% increase in resistance

$=\dfrac{R'-R}{R}\times 100=\dfrac{4R-R}{R}\times 100$

$=300\%$

**29. (22)** $X_L=\omega L=2\pi\times 50\times 10^{-1}=10\pi$

$X_X=\dfrac{1}{\omega C}=\dfrac{1}{2\pi\times 50}\times 10^4=\dfrac{100}{\pi}$

$R=10\Omega$

$Z=\sqrt{\left(10\pi-\dfrac{100}{\pi}\right)^2+10^2}\simeq 10\Omega$

$i = \frac{E}{2} \simeq \frac{220}{10} \simeq 22 \text{Amp}$

**30. (15)** Voltage Gain $= \frac{I_C}{I_B} \times \frac{R_0}{R_I} = \frac{10 \times 10^{-3}}{200 \times 10^{-6}} \times \frac{60}{200} = 15$

**31. (c)** $W = h\nu$

$= 6.6 \times 10^{-34} \times 1.3 \times 10^{15}$
$= 8.58 \times 10^{-19}$ J

**32. (c)** $\Delta H = \sum \Delta H_{\text{Combustion}}$ (Reactant) $- \sum \Delta H_{\text{Combustion}}$ (Product)

$= 3 \times (-1300) - [-3268]$
$= -632 \text{ kJ mol}^{-1}$

**33. (d)** $\Delta T = i k_f \times m$

$0.2 = i \times 1.86 \times \frac{0.7}{93} \times \frac{1000}{42}$

$i = \frac{0.2 \times 93 \times 6}{1.86 \times 100}$

$i = 0.60$

$2 A \rightleftharpoons A_2$

$1 - \alpha \quad \frac{\alpha}{2}$

$i = 1 - \alpha + \frac{\alpha}{2}$

$i = 1 - \frac{\alpha}{2}$

$1 - \frac{\alpha}{2} = 0.60$

$1 - 0.60 = \frac{\alpha}{2}$

$\alpha = 0.80$

**34. (a)** $Bi_2 S_3 \rightleftharpoons 2Bi^{3+} + 3 S^{2-}$

$k_{sp} = (2 s)^2 (3 s)^3$
$= 4 s^2 \times 27 (s)^3$
$= 108 (s)^5$

$(s)^5 = \frac{1.08 \times 10^{-73}}{108}$

$\Rightarrow s = 10^{-15}$

**35. (b)** Zymase naturally occurs in yeast.

Diastase is found in malt.

Urease is found in soya bean

Pepsin is found in stomach

**36.** **(d)** As Cl has maximum electron affinity among all elements.

| Element | $\Delta_{eg}\mathbf{H(kJ/mol)}$ |
|---|---|
| F | -328 |
| Cl | -349 |
| Te | -190 |
| Po | -174 |

**37.** **(a)** In the electro-refining, impure metal (here blister copper) is used as an anode while precious metal like Au, Pt get deposited as anode mud.

**38.** **(d)**

$$\underset{\text{Acid}}{H_2S} + \underset{\text{Base}}{H_2O} \rightleftharpoons H_3O^+ + HS^-$$

$$\underset{\text{Acid}}{H_2O} + \underset{\text{Base}}{NH_3} \rightleftharpoons NH_4OH$$

**39.** **(a)** $E^\circ_{Cl_2/Cl^-} = +1.36\ V$

$E^\circ_{I_2/I^-} = +0.54\ V$

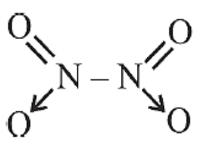
$E^\circ_{Ag^+/Ag} = +0.80\ V$

$E^\circ_{Na^+/Na} = -2.71\ V$

$E^\circ_{Li^+/Li} = -3.05\ V$

**40.** **(a)** $Pb(NO_3)_2 \underset{673\ K}{\overset{\Delta}{\rightarrow}} PbO + NO_2 + O_2$

$\underset{A}{2NO_2} \xrightarrow{\text{Dimerise}} N_2O_4$



(no bridged oxygen)

**41.** **(b)**

$V^{2+}$ : $1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,3d^3$

$\boxed{\uparrow}\boxed{\uparrow}\boxed{\uparrow}\boxed{\ }\boxed{\ }$ (3d) (unpaired $e^- = 3$)

$Ni^{2+}$ : $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^8$

$\boxed{\uparrow\downarrow}\boxed{\uparrow\downarrow}\boxed{\uparrow\downarrow}\boxed{\uparrow}\boxed{\uparrow}$ (3d) (unpaired $e^-$ = 2)

$Cr^{2+}$ : $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^4$

$\boxed{\uparrow}\boxed{\uparrow}\boxed{\uparrow}\boxed{\uparrow}\boxed{\ }$ (3d) (unpaired $e^-$ = 4)

$Fe^{2+}$ : $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^6$

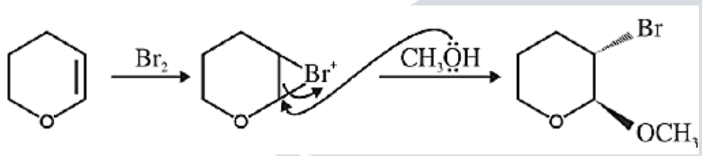
$\boxed{\uparrow\downarrow}\boxed{\uparrow}\boxed{\uparrow}\boxed{\uparrow}\boxed{\uparrow}$ (3d) (unpaired $e^-$ = 4)

**42. (c)** Clean water have BOD less than 5ppm while highly polluted water has BOD greater or equal to 17ppm. So, assertion is correct. BOD is measure of oxygen required to oxidise only bio-degradable organic matter. So, reason is false.

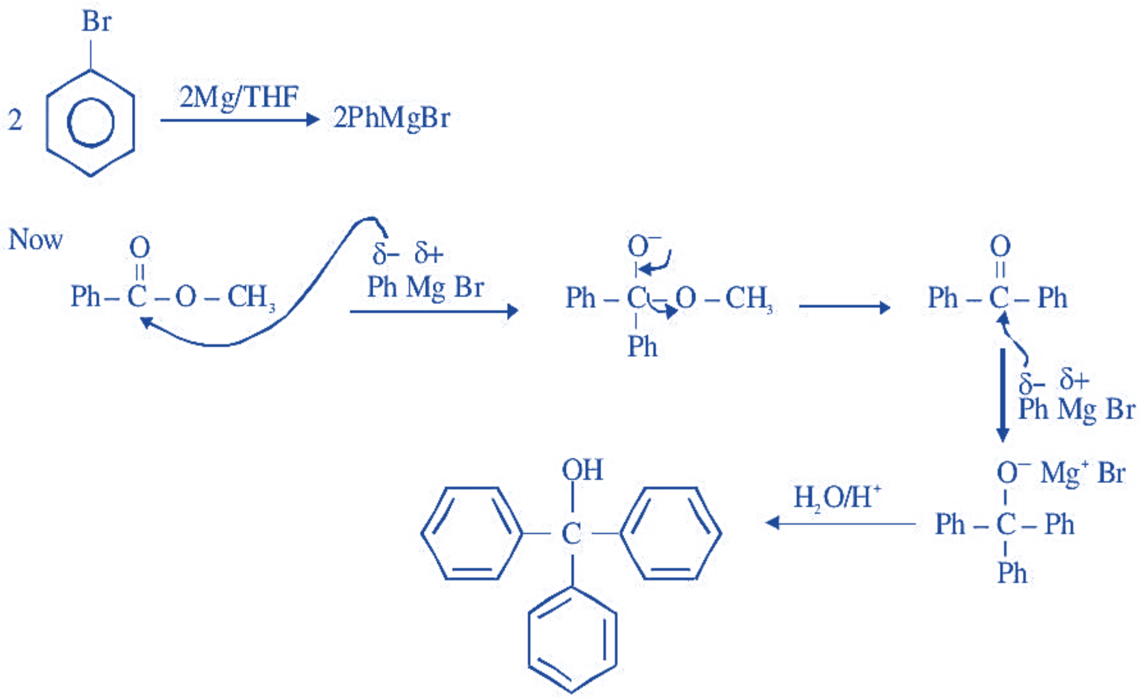
**43. (d)** Benzoic acid and Napthalene can be effectively separated by crystallization. Benzoic acid is soluble in hot water whereas Napthalene is insoluble. assertion is incorrect but reason is correct

**44. (b)** Sodium fusion extract is boiled with concentrated $HNO_3$ to remove sodium cyanide and sodium sulphide

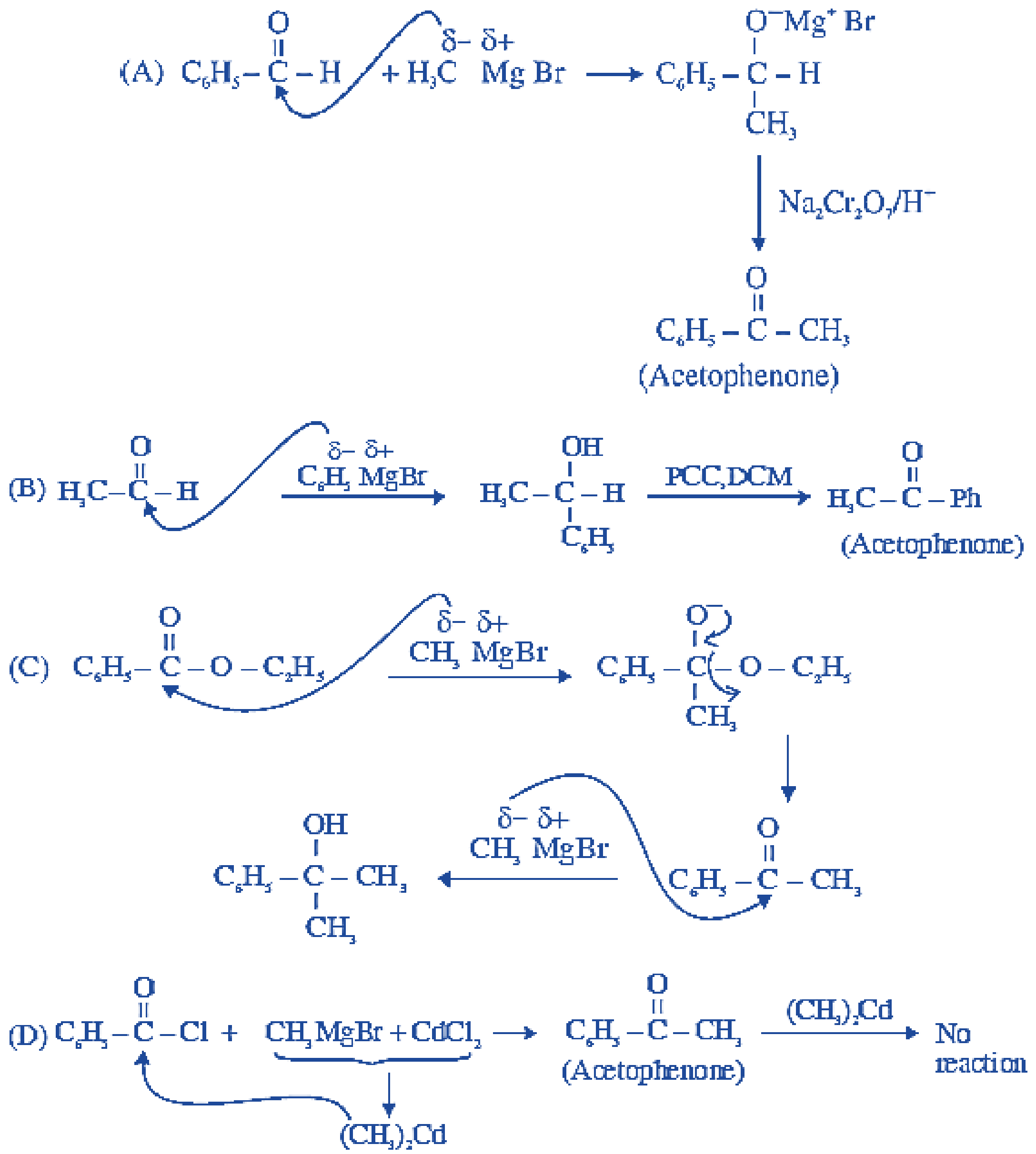
**45. (a)**



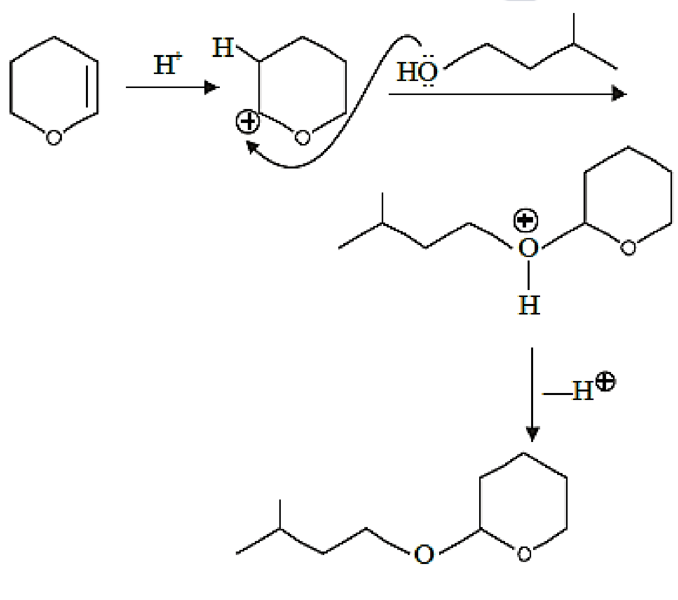

**46. (b)**



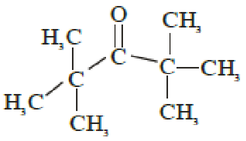

**47. (C)**


(A)
Na2Cr2O7/H−
(Acetophenone)
(B)
PCC,DCM
(Acetophenone)
(C)
(D)
(Acetophenone)
No reaction

**48. (d)**

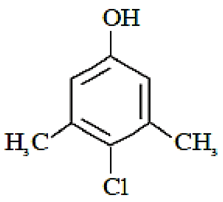

H+
—H⊕

**49. (c)** Enamine formation is an example of nucleophilic addition elimination reaction

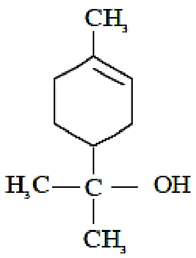
Since in ketone  Carbonyl

Group is highly sterically hindered hence attack of nucleophile will not be possible.

**50. (b)** Dettol is mixture of



and



Chloroxylenol
(Compound A)
It has $6\pi e^-$

Terpineol
(Compound B)
It has $2\pi e^-$

Hence compound ' B ' is Terpineol.

**51. (25)** 0.30% glycine is equal to 75

$$1\% \longrightarrow \frac{75}{0.30}$$
$$100\% \longrightarrow \frac{75}{0.30} \times 100$$
$$= 25000 \text{ g}$$

**52. (32)** $\frac{P_1}{T_1} = \frac{P_2}{T_2}$

$$\frac{30}{300} = \frac{P_2}{318}$$

$$P_2 = \frac{30}{300} \times 318$$

$$= \frac{1}{10} \times 318$$

$$= 32$$

**53. (3)** $BeF_2, BF_3$ and $CCl_4 \Rightarrow \mu_{\text{net}} = 0$

$H_2O, NH_3$ and $HCl \Rightarrow \mu_{\text{net}} \neq 0$

**54. (0)**

$$t_{1/2} \times \frac{1}{[P_0]^{n-1}}$$

$$\frac{t_1}{t_2} = \frac{(P_2)^{n-1}}{(P_1)^{n-1}}$$

$$\frac{340}{170} = \left(\frac{27.8}{55.5}\right)^{n-1}$$

$$\Rightarrow 2 = \frac{1}{(2)^{n-1}}$$

$n = 0$

**55. (20)** $Fe^{3+} + 3e^- \longrightarrow Fe$

$3\ F \longrightarrow 1$ mole Fe is deposited

For $56\ g \longrightarrow 3 \times 96500$ (required charge)

For $1\ g \longrightarrow \frac{3 \times 96500}{56}$ (required charge)

For $0.3482\ g \longrightarrow \frac{3 \times 96500}{56} \times 0.3482$

$= 1800.06$

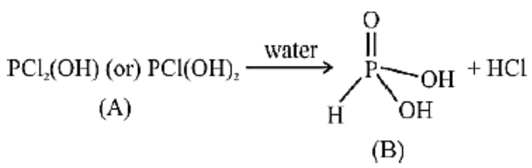
$Q = it$

$1800.06 = 1.5t$

$t = 20 min$

**56. (2)**

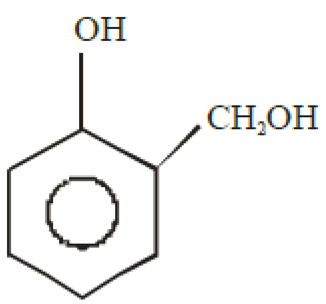
$$PCl_3 + H_2O \xrightarrow[\text{hydrolysis}]{\text{Partial}} PCl_2(OH) \text{ (or) } PCl(OH)_2 + HCl$$



no. of ionisable protons in B = 2

**57. (2)**

**58. (9)** Monomer unit of Novolac is



its molecular mass is 124amu.

Upon considering molecular weight of polymer as 963amu (In question its given as 963 gram) Now if during formation of Novolac, (n-1) unit of water are removed then

$$n \times 124 = 963 + [18 \times (n-1)]$$
$$n = 9$$

**59. (2)** Biuret test is given by all proteins and peptides having atleast two peptide linkages. Hence positive test must be given by tripeptide and Biuret.

**60. (3)**

**61. (b)** $A: x \in (-3,1)$ $B: x \in (-\infty,-1] \cup [3,\infty)$

$$B - A = (-\infty,-3] \cup [3,\infty) = R - (-3,3)$$

**62. (58)** $ax^2 - 2bx + 15 = 0$

$$2\alpha = \frac{2\text{ b}}{\text{a}}, \alpha^2 = \frac{15}{\text{a}}$$

$$\frac{\alpha}{2} = \frac{15}{2b}$$

$$\alpha = \frac{15}{\text{b}}$$

$$x^2 - 2bx + 21 = 0$$

$$\left(\frac{15}{b}\right)^2 - 2b\left(\frac{15}{b}\right) + 21 = 0$$

$$b^2 = 25$$

$$\alpha + \beta = 2b, \alpha\beta = 21$$

$$\alpha^2 + \beta^2 = 4b^2 - 42$$

$$= 58$$

**63. (c)** $\bar{z}_1 = i\bar{z}_2$

$$z_1 = -iz_2$$

$$\arg\left(\frac{\mathbf{z}_1}{\mathbf{z}_2}\right) = \pi$$

$$\arg\left(-i\frac{z_2}{\bar{z}_2}\right) = \pi \arg(z_2) = \theta$$

$$-\frac{\pi}{2} + \theta + \theta = \pi$$

$$2\theta = \frac{3\pi}{2}$$

$$\arg(z_2) = \theta = \frac{3\pi}{4}, \arg z_1 = \frac{\pi}{4}$$

**64. (d)**

**65. (a)**

$$\lim_{x\to\frac{\pi}{2}} \tan^2 x\left[\sqrt{2\sin^2 x+3\sin x+4}-\sqrt{\sin^2 x+6\sin x+2}\right]=$$

$$\lim_{x\to\frac{\pi}{2}} \frac{\tan^2 x[\sin^2 x-3\sin x+2]}{\sqrt{9}+\sqrt{9}}$$

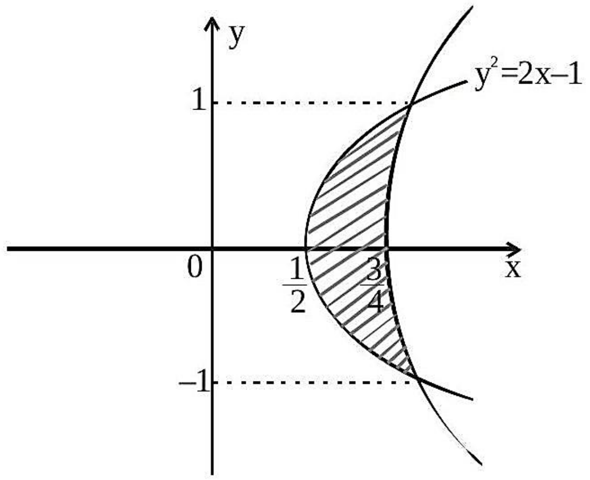
$$=\lim_{x\to\frac{\pi}{2}} \frac{\tan^2 x(\sin x-1)(\sin x-2)}{6}$$

$$=\frac{1}{6}\lim_{x\to\frac{\pi}{2}} \tan^2 x(1-\sin x)$$

$$=\frac{1}{6}\lim_{x\to\frac{\pi}{2}} \frac{\sin^2 x(1-\sin x)}{(1-\sin x)(1+\sin x)}=\frac{1}{12}$$

**66. (a)** Required area $=2\int_0^1\left(\frac{y^2+3}{4}-\frac{y^2+1}{2}\right)dy$

$$=2\int_0^1 \frac{1-y^2}{4}\,\mathrm{dy}=\frac{1}{2}\left|y-\frac{y^3}{3}\right|_0^1=\frac{1}{3}$$




**67. (a)**

$$(5+x)^{500}+x(5+x)^{499}+x^2(5+x)^{498}+\cdots.+x^{500}$$

$$=\frac{(5+x)^{501}-x^{501}}{(5+x)-x}=\frac{(5+x)^{501}-x^{501}}{5}$$

$\Rightarrow$ coefficient $x^{101}$ in given expression

$$=\frac{{}^{501}C_{101}5^{400}}{5}={}^{501}C_{101}5^{399}$$

**68. (b)** $S=1\cdot 3^0+2\cdot 3^1+3\cdot 3^2+\cdots..+10.3^9$

$3S=1\cdot 3^1+2.3^2\ldots\ldots\ldots\ldots\ldots\ldots\ldots+..+3^9+10\times 3^{10}$

$-2\,S=(1\cdot 3^0+3^1+3^2\ldots..3^9)-10.3^{10}$

$S = 5 \times 3^{10} - \left(\frac{3^{10} - 1}{4}\right)$

$S = \frac{20.3^{10} - 3^{10} + 1}{4} = \frac{19.3^{10} + 1}{4}$

**69. (c)** $P_1 + \lambda P_2 = 0$

$\Rightarrow (x + 3y - z - 5) + \lambda(2x - y + z - 3) = 0$

$(2,1,-2)$ lies on this plane

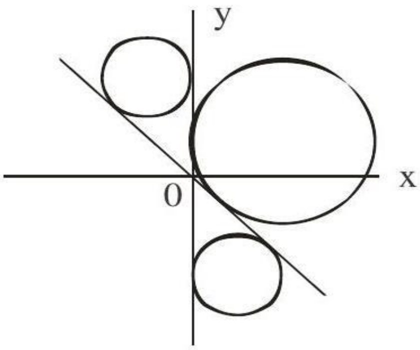
$\therefore \lambda = 1 \Rightarrow$ plane is $3x + 2y - 8 = 0$

**70. (d)** Let $(h, k)$ is centre of circle

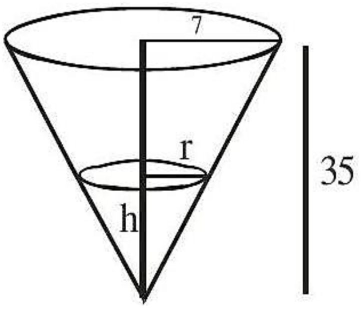
$\left|\frac{h - k}{\sqrt{2}}\right| = |h|$

$k^2 - h^2 + 2hk = 0$

$\therefore$ Equation of locus is $y^2 - x^2 + 2xy = 0$




**71. (c)** From figure $\frac{r}{h} = \frac{7}{35} \Rightarrow h = 5r$




Given $\frac{dV}{dt} = 1 \Rightarrow \frac{d}{dt}\left(\frac{\pi r^2 h}{3}\right) = 1$

$\Rightarrow \frac{d}{dt}\left(\frac{5\pi}{3} r^3\right) = 1 \Rightarrow r^2 \frac{dr}{dt} = \frac{1}{5\pi}$

Let wet conical surface area $= S$

$= \pi r \ell = \pi r \sqrt{h^2 + r^2}$

$= \sqrt{26}\pi r^2 \Rightarrow \frac{dS}{dt} = 2\sqrt{26}\pi r\frac{dr}{dt}$

When $h = 10$ then $r = 2 \Rightarrow \frac{dS}{dt} = \frac{2\sqrt{26}}{10}$

**72. (d)** $b_n = \int_0^{\pi/2} \frac{1+\cos 2nx}{\sin x} dx$

$b_{n+1} - b_n = \int_0^{\pi/2} \frac{\cos^2(n+1)x - \cos^2 nx}{\sin x} dx$

$= \int_0^{\pi/2} \frac{-\sin(2n+1)x\sin x}{\sin x} dx$

$= \left(\frac{\cos(2n+1)x}{2n+1}\right)_0^{\pi/2} = \frac{-1}{2n+1}$

$\frac{1}{b_3-b_2}, \frac{1}{b_4-b_3}, \frac{1}{b_5-b_4}$ are in A.P. with c.d. $= -2$

**73. (b)** $\frac{dy}{dx} - \frac{y}{x} = -\frac{3}{2}\left(\frac{y}{x}\right)^2 \quad y = vx$

$\frac{dv}{v^2} = -\frac{3dx}{2x}$

$-\frac{1}{v} = -\frac{3}{2}\ln|x| + C$

$-\frac{x}{y} = \frac{-3}{2}\ln|x| + C$

$x = e, y = \frac{e}{3}$

$C = -\frac{3}{2}$

When $x = 1, y = \frac{2}{3}$

**74. (c)** $\frac{dy}{dx} = \frac{2(1+\sin t)\times\cos t}{1+\cos 2t}$

$\Rightarrow \frac{2(1+\sin t)\cos t}{2\cos^2 t} = \sqrt{3}$

$\Rightarrow t = \frac{\pi}{6}, y_0 = 27$

**75. (d)** $\sin 12° + \sin 12° - \sin 72°$

$= \sin 12° - 2\cos 42° \sin 30°$

$= \sin 12° - \sin 48°$

$= -2\cos 30° \sin 18°$

$= -2 \times \frac{\sqrt{3}}{2} \times \frac{\sqrt{5}-1}{4}$

$= \frac{\sqrt{3}}{4}(1-\sqrt{5})$

**76. (d)** $P(n) = \frac{1}{n}$

$P(2) = \frac{1}{2}$ $P(8) = \frac{1}{8}$

$P(4) = \frac{1}{4}$ $P(16) = \frac{1}{16}$

$P(32) = \frac{2}{32}$

Possible cases

16,16,16 and 32,8,8

Probability $= \frac{1}{16^3} + \frac{2}{32} \times \frac{1}{8} \times \frac{1}{8} \times 3 = \frac{13}{16^3}$

**77. (c)** $\sim p \vee q \equiv p \rightarrow q$

$\sim q \wedge p \equiv \sim (p \rightarrow q)$

Negation of $\sim (p \rightarrow q) \rightarrow (p \rightarrow q)$

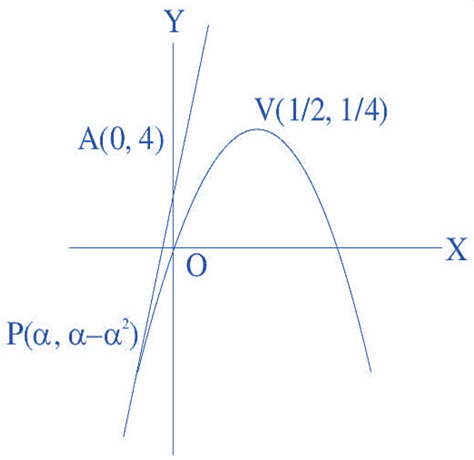
is $\sim (p \rightarrow q) \wedge (\sim (p \rightarrow q))$ i.e. $\sim (p \rightarrow q)$

**78. (c)** Slope of tangent at P = Slope of line AP

$y'|_P = 1 - 2\alpha = \frac{\alpha - \alpha^2 - 4}{\alpha}$

Solving $\alpha = -2 \Rightarrow P(-2, -6)$

Slope of PV $= \frac{5}{2}$



**79. (b)** $\tan^{-1}\left[\frac{\cos\left(4\pi-\frac{\pi}{4}\right)-1}{\sin\frac{\pi}{4}}\right] \Rightarrow \tan^{-1}\left(\frac{\cos\frac{\pi}{4}-1}{\sin\frac{\pi}{4}}\right)\tan^{-1}\left(\frac{1-\sqrt{2}}{1}\right)=-\frac{\pi}{8}$

**80. (a)** Ellipse $x^2+2y^2=4$

Line $y=x+1$

Point of intersection

$x^2+2(x+1)^2=4$

$3x^2+4x-2=0$

$|x_1-x_2|=\frac{\sqrt{40}}{3}$

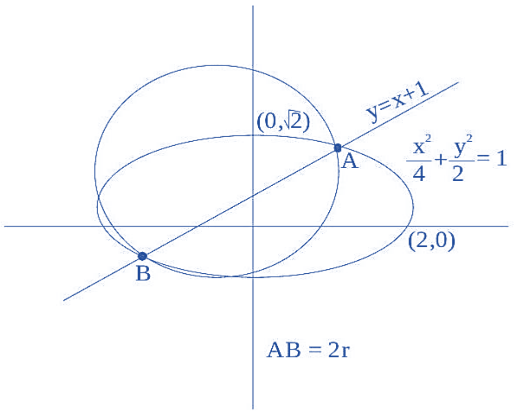
$AB=2r=|x_1-x_2|\sqrt{1+m^2}$,

m is slope of given line

$AB=\frac{\sqrt{40}}{3}\sqrt{1+1}$

$2r=\frac{\sqrt{80}}{3}\Rightarrow r=\frac{\sqrt{80}}{6}$

$(3r)^2=\left(3\times\frac{\sqrt{80}}{6}\right)^2=\frac{80}{4}=20$




**81. (1)** $A^2=A$ and $B^2=B$

Therefore equation $nA^n+mB^m=I$ becomes $nA+mB=I$, which gives $m=n=1$ Only one set possible

**82. (62)** $f(g(x))=[2g^2(x)]+1$

$$=\begin{cases}[2(2x-3)^2]+1; x<0\\ [2(2x+3)^2]+1; x\geq 0\end{cases}$$

$\therefore$ fog is discontinuous whenever $2(2x-3)^2$ or $2(2x+3)^2$ belongs to integer except $x=0$.

$\therefore$ 62 points of discontinuity.

**83. (6)** $\frac{12}{3}\left[\int_3^b\left(\frac{1}{x^2-4}-\frac{1}{x^2-1}\right)dx\right]=\log\frac{49}{40}$

$$\frac{12}{3}\cdot\left[\frac{1}{4}\ln\left|\frac{x-2}{x+2}\right|-\frac{1}{2}\ell n\left|\frac{x-1}{x+1}\right|\right]_3^b=\log\frac{49}{40}$$

$$\ln\frac{(b-2)(b+1)^2}{(b+2)(b-1)^2}=\ln\frac{49}{50}$$

b = 6

**84. (83)** $T_{r+1}={}^{10}C_r(2x^3)^{10-r}\left(\frac{3}{x}\right)^r$

$={}^{10}\mathrm{C}_r2^{10-r}3^r x^{30-4r}$

Put $r=0,1,2,\ldots.7$ and we get $\beta=83$

**85. (21)** Mean deviation about mean of first n natural numbers is $\frac{n^2-1}{4n}$ $\therefore n=21$

**86.** (**14**) $(\vec{a}\times\vec{b})\cdot\vec{b}=0$

$\Rightarrow 13-1-4\lambda=0\Rightarrow\lambda=3$
$\Rightarrow\vec{b}=\hat{\imath}+\hat{\jmath}+3\hat{k}\Rightarrow\vec{a}\times\vec{b}=13\hat{\imath}-\hat{\jmath}-4\hat{k}$
$\Rightarrow(\vec{a}\times\vec{b})\times\vec{b}=(13\hat{\imath}-\hat{\jmath}-4\hat{k})\times(\hat{\imath}+\hat{\jmath}+3\hat{k})$
$\Rightarrow-21\vec{b}-11\vec{a}=\hat{\imath}-43\hat{\jmath}+14\hat{k}$
$\Rightarrow\vec{a}=-2\hat{\imath}+2\hat{\jmath}-7\hat{k}$

Now$(\vec{b}-\vec{a})\cdot(\hat{k}-\hat{\jmath})+(\vec{b}+\vec{a})\cdot(\hat{\imath}-\hat{k})=14$

**87. (243)** If 0 taken twice then ways = 9

If 0 taken once then ${}^9C_1\times2=18$

If 0 not taken then ${}^9C_1\,{}^8C_1\cdot3=216$

Total = 243

**1. (3)**

$$f(x)=\begin{cases}(x^2-1)(x-3)+(x-3), x\in(0,1]\cup[3,4)\\ -(x^2-1)(x-3)+(x-3), x\in[1,3]\end{cases}$$

$$\Rightarrow f'(x)=\begin{cases}3x^2-6x, x\in(0,1)\cup(3,4)\\ -3x^2+6x+2, x\in(1,3)\end{cases}$$

f(x) is non-derivable at x = 1 and x = 3

also $f'(x)=0$ at $x=1+\sqrt{\frac{5}{3}}\Rightarrow m+M=3$

**89. (85)** $e^2=1+\frac{b^2}{a^2}=\frac{25}{16}\Rightarrow\frac{b^2}{a^2}=\frac{9}{16}$

$A\left(\frac{8}{\sqrt{5}}, \frac{12}{5}\right)$ satisfies $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$

$\Rightarrow \frac{64}{5a^2} - \frac{144}{25\,b^2} = 1$ .....(2)

Solving (1) & (2) $b = \frac{6}{5}$ $a = \frac{8}{5}$

Normal at $A$ is $\frac{\sqrt{5}a^2x}{8} + \frac{5b^2y}{12} = a^2 + b^2$

Comparing it $8\sqrt{5}x + \beta y = \lambda$

Gives $\lambda = 100, \beta = 15$

$\lambda - \beta = 85$

**90. (51)** $8x + 4\sqrt{2}y = 1, z = 0$

$$\Rightarrow \frac{x - \frac{1}{8}}{1} = \frac{y - 0}{-\sqrt{2}} = \frac{z - 0}{0} = \lambda$$

$$-8x - 6\sqrt{3}z = 1, y = 0$$

$$\Rightarrow \frac{x + \frac{1}{8}}{3\sqrt{3}} = \frac{y - 0}{0} = \frac{z - 0}{-4}$$

$$\begin{vmatrix} \frac{1}{4} & 0 & 0 \\ 1 & -\sqrt{2} & 0 \\ 3\sqrt{3} & 0 & -4 \end{vmatrix} = \sqrt{2}$$

$$d = \frac{1}{\sqrt{51}}$$

$$\frac{1}{d^2} = 51$$